K.C. NAIDU* & H.M. DEVI*: Embryology of two species of *Begonia*

K.C. ナイヅ*・H.M. デビ*: ベゴニア属2種の花粉と珠胚形成

The genus *Begonia* (Michael Begon), a member of Begoniaceae, is native of subtropical region, especially of south America and is widely cultivated for its colourful foliage and flowers. Although the genus comprises 900 species, very little work has been done on its embryology (Madulata 1950, Swamy & Parameswaran 1960, Devi & Naidu 1979, 1982, Devi et al. 1982). It was therefore proposed to study the embryology of two species, *Begonia metallica* G. Smith and *Begonia Roxburghii* A. DC.

Materials and methods The materials of different stages of flower development were collected from Lal Baugh Garden, Bangalore and fixed in formalin-acetic-alcohol. Customary methods of dehydration, clearing and embedding were followed (Johansen 1940). Sections cut between 4-10 μ thickness were stained in Delafield's haematoxylin.

Observations

Microsporangium, microsporogenesis and male gametophyte. The anther is tetrasporangiate (Fig. 1). The hypodermal archesporium in transection consists of three cells. The development of the anther wall corresponds to the dicotyledonous type (Davis 1965) (Figs. 2-4) due to periclinal division in the cells of middle layer, thus two layers are formed (Fig. 4). The tapetum is of the secretory type and is uniseriate with uninucleate cells (Figs. 3, 4), which later due to mitotic divisions contain 2 or 3 nuclei (Figs. 5, 6). At the time of dehiscence the endothecium develops fibrous thickenings (Fig. 5). The epidermis remains persistent. As the result of simultaneous cytokinesis in the pollen mother cells tetrahedral and decussate types of pollen tetrads are formed (Figs. 7-9). The pollen grains are oblong or ellipsoidal, tricolpate with smooth exine and a thin hyaline intine and are shed at 2 nucleate stage (Figs. 10-12).

In both the species, most of the anthers degenerate as a whole after completion of the first meiotic division of pollen mother cells. As the result, a

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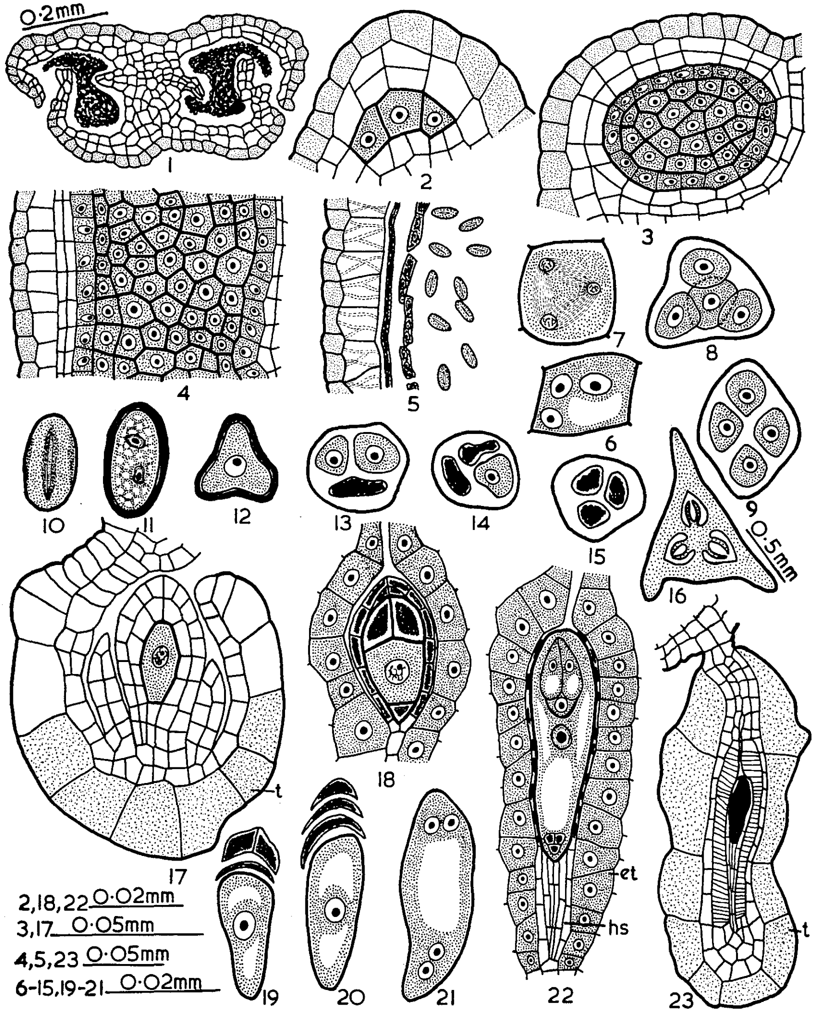

Figs. 1, 2, 5, 9, 10, 12, 16, 18, 19, 21: *B. Roxburghii.*
Figs. 3, 4, 6-8, 11, 13-15, 17, 20, 22, 23: *B. metallica.*

Fig. 1. Degenerating anther. Figs. 2-5. Transverse section and longitudinal section of anther lobes showing development of wall layers. Fig. 6. Three-nucleate tapetal cell. Fig. 7. PMC in meiotic division. Figs. 8, 9. Tetrahedral and decussate pollen tetrads. Figs. 10-12. Pollen grains. Figs. 13-15. Pollen tetrads with degenerating pollen grains. Fig. 16. Transverse section of ovary. Fig. 17. Longitudinal section of ovule. Fig. 18. T-shaped megaspore tetrad. Note the formation of endothelium. Figs. 19-22. Stages in the development of embryo sac. Fig. 23. Degenerating ovule.

degenerating mass of dividing pollen mother cells is formed inside the pollen sacs and thus followed by the degeneration of wall layers and connective tissue (Fig. 1). Still in some other cases degeneration of pollen at different stages of development is quite common. Usually one, two or all the four microspores in each tetrad become abortive (Figs. 13–15). An interesting feature in these species is the presence of tannin in the epidermal cells of the anther.

Ovary, ovule, megasporogenesis and female gametophyte. The ovary is inferior, tricarpellary syncarpous and trilocular. The projecting axile placentae are bifurcated and bear numerous ovules (Fig. 16). The ovule is anatropous, bitegmic and weakly crassinucellate (Fig. 17). Both outer and inner integuments contain two layers of cells. The hypodermal archesporium is single-celled. It cuts off an outer primary parietal cell and an inner megaspore mother cell. The primary parietal cell undergoes anticlinal divisions to produce a layer of parietal cells (Fig. 17). With the differentiation and growth of the megaspore mother cell, the nucellus becomes disorganised except a few parietal cells at the micropylar end. Thus, very soon, the embryo sac comes to lie in contact with the inner layer of the inner integument. Then the cells of the inner layer of the inner integument elongate radially, accumulate abundant cytoplasm and differentiate into the endothelium (Fig. 18). The cells of chalaza, below the embryo sac become thin-walled, elongate longitudinally and differentiate into well-developed hypostase. Meanwhile, the megaspore mother cell undergoes meiosis and produces either linear or T-shaped megaspore tetrad (Figs. 19, 20). Development of the embryo sac folllows the *Polygonum* type (Figs. 19–22). The synergids are pear-shaped. The three uninucleate antipodals are ephemeral.

Abnormal behaviour of the endothelium. In a few ovules, simultaneously with the development of the eight-nucleate embryo sac, the cells of the endothelium accumulates adundant food material, elongate radially and from either side enchroach and crush the embryo sac (Fig. 23). Simultaneously the cells of the hypostase also grow towards the micropylar region and finally join the endothelium in crushing the embryo sac. Ultimately, the ovary wall also becomes disorganised and finally all the tissues get disintegrated. Thus all the ovules in *B. metallica* and about 90% in *B. Roxburghii* completely become degenerated by the time an eight-nucleate embryo sac is formed (Fig. 23).

Discussion Anther, pollen and male gametophyte development are identical in all the members so far investigated (Madulata 1956, Swamy & Parameswaran

1960, Devi & Naidu 1979, Devi et al. 1982 and present data). In the two species presently investigated, the ovule is anatropous, bitegmic and weakly crassinucellate as is known to the family. However, Sandt (1921) in *B. tuberosa*, *B. fraebeli*, *B. hirtella* and *B. muricata*, Irmischer (1925) in a few species of *Begonia* and Swamy & Parameswaran (1960) in *B. crenata* reported bitegmic and tenuinucellate ovules. Further, Swamy & Parameswaran (1960) stated that the nucellus consists of an axile row of 3-5 cells below the epidermis and a parietal cell being cut off, by the archesporial cell. This shows clearly that the megaspore mother cell is separated from the nucellus epidermis by a parietal cell and as such it may not be proper to regard the ovules as tenuinucellate. The nucellus including its epidermis degenerates soon and the embryo sac directly comes in contact with the inner layer of the inner integument as in *B. crenata* (Swamy & Parameswaran 1960) and the inner integument differentiates as the endothelium. According to Sandt (1921) the outermost layer of the nucellus develops into the epithelium in the species studied by him. Swamy & Parameswaran (1960) and the present authors believe that the epithelium reported by Sandt (1921) can be identified with the innermost layer of the inner integument.

Normally the endothelium is nutritive and protective in function. But in some ovules of the species investigated up to the present, the endothelial cells behave abnormally. Due to anther and ovular degenerations in these two species no seed is formed; therefore, reproduction occur by vegetative propagation.

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Begonia metallica と *B. Roxburghii* の花粉と胚珠の形成を調べた。両種とも同じである。花粉形成は tetrahedral and decussate type であり，タペータムは secretory type である。花粉は2核の時期に放出される。胚珠は倒生で2枚の珠皮があり，胚嚢のまわりに endothelium が作られる。胚嚢形成は *Polygonum* type である。胚嚢形成までは行うが胚珠は殆んどが退化してしまう。したがってこの2種は種子を作らない。増殖は栄養繁殖による。

□譚 沛祥：**華南杜鵑花誌** (Tam Pui-cheung: A survey of genus *Rhododendron* in South China). 119 pp., 色彩図 4, カラー写真 2, 線画 38. 香港広宇出版社. 1983. ¥4,000. 中国南部の広東・広西・福建・湖南・江西の五省に分布するツツジ属の総説である。120種，14変種が集録されている。このうち半分の51種が新種とされ，18種は新分布のもので，従来この地域に32種しか知られていなかったというから，種類の再検討を経なければならないとしても，著しく解明されたわけである。華南植物研究所の標本をもとにし，その他に広西植物研究所，廬山植物研究所など，華南にある6標本室所蔵の標本の調査でまとめられたものである。中国語による検索と詳細な種の記載，標本の引用があり，後半に英文による検索，ラテン文による新種や新変種の記載がある。中国のツツジ属の本格的な基礎研究である。

ツツジ属の研究は数多く，最近もヨーロッパから日本や中国のツツジ属をまとめた論文がだされている。しかし，その報告の日本の部分を見るかぎり，実体とはかなりかけはなれたまとめかたをしている。中国のツツジ属についてもやはり同じ扱いが見られるのではないかと想像される。現地での豊富な資料のもとに研究が行なわれないと本当のことはわからない典型的な例を示している。

雲南，四川はシャクナゲ類の宝庫である。中国で本書のような基礎的な研究がまとめられたことは，いずれこの地域の現地の研究者によって本格的な研究がまとめられるであろうことを思わせ，その豪華さが今から期待される。 (山崎 敬)